Jan. 26, 1937. A. J. DEKKER 2,068,792

SCREW PROPELLER, TURBINE ROTOR, AND LIKE DEVICE

Filed June 15, 1935

Fig. 1.

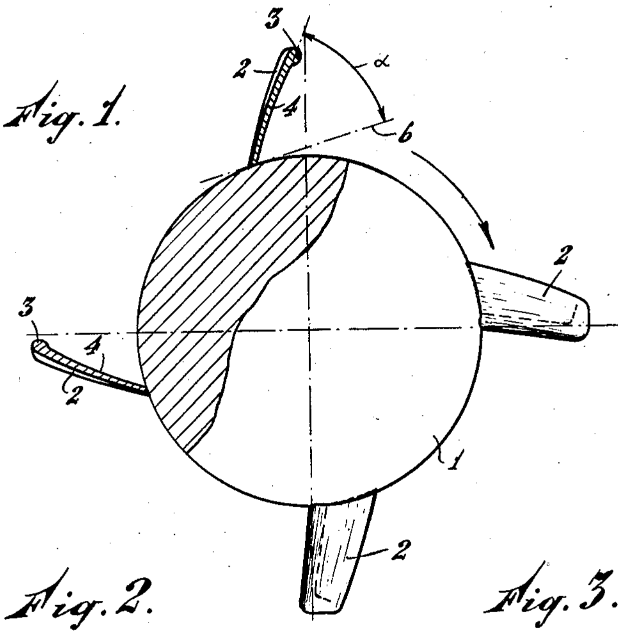


Fig. 2.

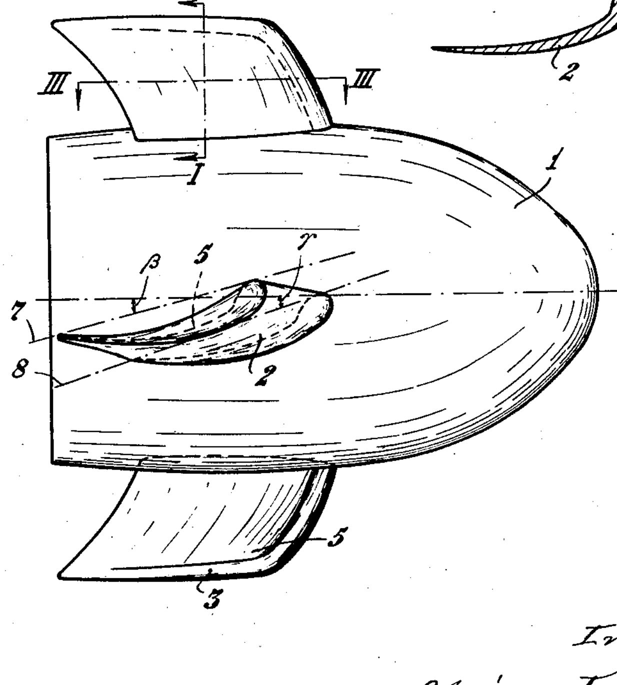
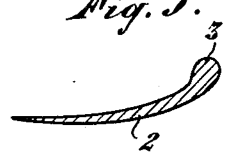


Fig. 3.



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SCREW PROPELLER, TURBINE ROTOR, AND LIKE DEVICE

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11 Claims. (Cl. 170—159)

The present invention relates to screw propellers, turbine rotors and like devices, the term "like devices" being intended to cover rotary fans, windmills and other rotatable elements having inclined blades and adapted either to transmit energy to a fluid medium when rotated or to be driven by the passage of a fluid medium parallel to their axes of rotation. For convenience the term "rotary device" will be employed hereinafter to designate such screw propellers, turbine rotors and like devices.

In the improved rotary device according to the present invention, which consists of a plurality of blades mounted on a hub, the length of each blade from root to tip is between one quarter and one half the diameter of the hub, the cross sections of the blades taken on any cylindrical surface coaxial with the axis of rotation as well as the cross sections taken on any surface normal to the said axis are similar to those of lifting air foils and the mounting of the blades on the hub is such that the chords of the blades make an angle of between 5° and 40° with planes containing the axis of rotation and intersecting said blades.

When the rotary device according to the present invention is used in place of a screw propeller of the existing type, it will be found that a lower circumferential velocity is necessary to effect propulsion at a given horizontal speed and less fuel is consumed after a given distance has been travelled. Further, the device operates more quietly than known propellers.

Further constructional features which may with advantage be embodied in the rotary device according to the present invention, but are not essential will be apparent from the following description of one embodiment of the invention which is illustrated diagrammatically in the accompanying drawing, in which:

Fig. 1 is a front view partly sectioned in the line I—I in Fig. 2.

Fig. 2 is a side elevation.

Fig. 3 is a cross section of a blade in the line III—III of Fig. 2.

The rotary device illustrated in the drawing consists of a hub 1 of streamline form which carries four blades 2 on its circumference. The leading end of the hub either has the form of a semi-ellipsoid or is approximately semi-ellipsoidal.

The blades 2 are relatively short by comparison with the diameter of the hub 1, the length of each blade from root to tip being between one quarter and one half the greatest diameter of the hub. In practice the best results have been obtained when the ratio of blade length to hub diameter is approximately 1:3.

The shape of the blades 2 is such that their cross sections taken on any cylindrical surface co-axial with the axis of rotation of the device as well as the cross sections taken on any surface normal to the said axis are similar to lifting airfoils (see Figs. 1 and 3). By "lifting airfoils" I intend to refer to a blade or wing section bounded by an upper convex surface and a lower concave surface with the spacing between the upper and lower surfaces decreasing from the leading edge to the trailing edge.

The blades 2 are mounted on the hub 1 so that their chords 7 make an angle β of between 5° and 40° with planes containing the axis of rotation of the device and intersecting the blades. The best results have been obtained in practice when the blade angle β is approximately 20°.

The blades 2 are not arranged radially of the hub 1, but are slightly tilted in the direction of rotation, so that the line 4 denoting the junction of the pressure surface 5 of a blade 2 with any plane cutting the blade and normal to the axis of rotation of the device (such as the sectional plane on which part of Fig. 1 is taken) makes with the tangent 6 to the surface of the hub 1 at the blade root an angle α of less than 90°. The tip of each blade is slightly bent in the direction of rotation and, in the embodiment illustrated, is provided with a thickened portion 3 on the pressure side.

As is clear from Fig. 2, the breadth of each blade from leading edge to trailing edge increases from root to tip and the length from root to tip is less than the minimum breadth from leading edge to trailing edge.

The blade angle or, in other words, the angle made by the chord of each blade 2 with planes containing the axis of rotation and intersecting said blade also decreases from root to tip ($\beta<\gamma$). For instance, at the root of the blade, the chord 8 forms an angle γ with the plane containing the axis of rotation and intersecting the blade, and at the tip of the blade the chord 7 forms an angle β with said plane, the angle γ being greater than the angle β.

When the present invention is applied to a rotary device serving as a propeller or for imparting energy to a fluid medium the blades 2 are arranged, as shown in the drawing, with their concave pressure surfaces facing slightly towards the rear of the device. When however, the rotary device is designed to be driven by the passage of a fluid medium parallel to its axis of ro-

tation, the only modification necessary is that the concave pressure surface faces slightly towards the leading end of the device.

I claim:

1. Improved rotary device, having inclined blades and adapted either to transmit energy to a fluid medium when rotated or to be driven by the passage of a fluid medium parallel to their axes of rotation, comprising a hub, a plurality of blades mounted on the hub, the cross sections of the blades taken on any cylindrical surface coaxial with the axis of rotation of the hub as well as the cross sections of the blades taken on any surface normal to the axis of rotation of the hub being similar to those of lifting airfoils.

2. Improved rotary device comprising a hub, a plurality of inclined blades mounted on the hub, the cross sections of the blades taken on any cylindrical surface coaxial with the axis of rotation of the hub as well as the cross sections of the blades taken on any surface normal to the said axis being similar to those of lifting airfoils, the length of each blade from root to tip being between one quarter and one half the diameter of the hub.

3. Improved rotary device comprising a hub, a plurality of inclined blades mounted on the hub, the cross sections of the blades taken on any cylindrical surface coaxial with the axis of rotation of the hub as well as the cross sections of the blades taken on any surface normal to the said axis being similar to those of lifting airfoils, the length of each blade from root to tip being between one quarter and one half the diameter of the hub, the mounting of the blades on the hub being such that the chords of the blades make an angle of between 5° and 40° with planes containing said axis of rotation and intersecting said blades.

4. Improved rotary device comprising a hub, a plurality of inclined blades mounted on the hub, the cross sections of the blades taken on any cylindrical surface coaxial with the axis of rotation of the hub as well as the cross sections of the blades taken on any surface normal to the said axis being similar to those of lifting airfoils, the length of each blade from root to tip being between one quarter and one half the diameter of the hub, the mounting of the blades on the hub being such that the chords of the blades make an angle of between 5° and 40° with planes containing said axis of rotation and intersecting said blades, and wherein the line denoting the junction of the pressure surface of each blade with any plane cutting said blade and normal to said axis of rotation makes with the tangent to the surface of the hub at the blade root in that plane an angle of less than 90°.

5. Improved rotary device comprising a hub, a plurality of inclined blades mounted on the hub, the cross sections of the blades taken on any cylindrical surface coaxial with the axis of rotation of the hub as well as the cross sections of the blades taken on any surface normal to the said axis being similar to those of lifting airfoils, the length of each blade from root to tip being between one quarter and one half the diameter of the hub, the mounting of the blades on the hub being such that the chords of the blades make an angle of between 5° and 40° with planes containing said axis of rotation and intersecting said blades, and wherein the line denoting the junction of the pressure surface of each blade with any plane cutting said blade and normal to said axis of rotation makes with the tangent to the surface of the hub at the blade root in that plane an angle of less than 90°, and wherein the tip of each blade is slightly bent in the direction of rotation.

6. Improved rotary device comprising a hub, a plurality of inclined blades mounted on the hub, the cross sections of the blades taken on any cylindrical surface coaxial with the axis of rotation of the hub as well as the cross sections of the blades taken on any surface normal to the said axis being similar to those of lifting airfoils, the length of each blade from root to tip being between one quarter and one half the diameter of the hub, the mounting of the blades on the hub being such that the chords of the blades make an angle of between 5° and 40° with planes containing said axis of rotation and intersecting said blades, and wherein the line denoting the junction of the pressure surface of each blade with any plane cutting said blade and normal to said axis of rotation makes with the tangent to the surface of the hub at the blade root in that plane an angle of less than 90°, and wherein the tip of each blade is slightly bent in the direction of rotation and is provided with a thickened portion on the pressure side.

7. Improved rotary device comprising a hub, a plurality of inclined blades mounted on the hub, the cross sections of the blades taken on any cylindrical surface coaxial with the axis of rotation of the hub as well as the cross sections of the blades taken on any surface normal to the said axis being similar to those of lifting airfoils, the length of each blade from root to tip being between one quarter and one half the diameter of the hub, the mounting of the blades on the hub being such that the chords of the blades make an angle of between 5° and 40° with planes containing said axis of rotation and intersecting said blades, and wherein the line denoting the junction of the pressure surface of each blade with any plane cutting said blade and normal to said axis of rotation makes with the tangent to the surface of the hub at the blade root in that plane an angle of less than 90°, and wherein the tip of each blade is slightly bent in the direction of rotation and is provided with a thickened portion on the pressure side, the hub being of streamline form.

8. Improved rotary device comprising a hub, a plurality of inclined blades mounted on the hub, the cross sections of the blades taken on any cylindrical surface coaxial with the axis of rotation of the hub as well as the cross sections of the blades taken on any surface normal to the said axis being similar to those of lifting airfoils, the length of each blade from root to tip being between one quarter and one half the diameter of the hub, the mounting of the blades on the hub being such that the chords of the blades make an angle of between 5° and 40° with planes containing said axis of rotation and intersecting said blades, and wherein the line denoting the junction of the pressure surface of each blade with any plane cutting said blade and normal to said axis of rotation makes with the tangent to the surface of the hub at the blade root in that plane an angle of less than 90°, and wherein the tip of each blade is slightly bent in the direction of rotation and is provided with a thickened portion on the pressure side, the hub being of streamline form and wherein the leading end of the hub is of semi-ellipsoidal form.

9. Improved rotary device comprising a hub, a plurality of inclined blades mounted on the

hub, the cross sections of the blades taken on any cylindrical surface coaxial with the axis of rotation of the hub as well as the cross sections of the blades taken on any surface normal to the said axis being similar to those of supporting planes lifting airfoils, the length of each blade from root to tip being between one quarter and one half the diameter of the hub, the mounting of the blades on the hub being such that the chords of the blades make an angle of between 5° and 40° with planes containing said axis of rotation and intersecting said blades, and wherein the line denoting the junction of the pressure surface of each blade with any plane cutting said blade and normal to said axis of rotation makes with the tangent to the surface of the hub at the blade root in that plane an angle of less than 90°, and wherein the tip of each blade is slightly bent in the direction of rotation and is provided with a thickened portion on the pressure side, the hub being of streamline form and wherein the leading edge of the hub is of semi-ellipsoidal form, the length of each blade from root to tip being shorter than the minimum length from leading edge to trailing edge.

10. Improved rotary device comprising a hub, a plurality of inclined blades mounted on the hub, the cross sections of the blades taken on any cylindrical surface coaxial with the axis of rotation of the hub as well as the cross-sections of the blades taken on any surface normal to the said axis being similar to those of lifting airfoils, the length of each blade from root to tip being between one quarter and one half the diameter of the hub, the mounting of the blades on the hub being such that the chords of the blades make an angle of between 5° and 40° with planes containing said axis of rotation and intersecting said blades, and wherein the line denoting the junction of the pressure surface of each blade with any plane cutting said blade and normal to said axis of rotation makes with the tangent to the surface of the hub at the blade root in that plane an angle of less than 90°, and wherein the tip of each blade is slightly bent in the direction of rotation and is provided with a thickened portion on the pressure side, the hub being of streamline form and wherein the leading edge of the hub is of semi-ellipsoidal form, the length of each blade from root to tip being shorter than the minimum length from leading edge to trailing edge and the length from leading edge to trailing edge of the blades being shorter at their roots than at their tips.

11. Improved rotary device comprising a hub, a plurality of inclined blades mounted on the hub, the cross sections of the blades taken on any cylindrical surface coaxial with the axis of rotation of the hub as well as the cross sections of the blades taken on any surface normal to the said axis being similar to those of lifting airfoils, the length of each blade from root to tip being between one quarter and one half the diameter of the hub, the mounting of the blades on the hub being such that the chords of the blades make an angle of between 5° and 40° with planes containing said axis of rotation and intersecting said blades, and wherein the line denoting the junction of the pressure surface of each blade with any plane cutting said blade and normal to said axis of rotation makes with the tangent to the surface of the hub at the blade root in that plane an angle of less than 90°, and wherein the tip of each blade is slightly bent in the direction of rotation and is provided with a thickened portion on the pressure side, the hub being of streamline form and wherein the leading edge of the hub is of semi-ellipsoidal form, the length of each blade from root to tip being shorter than the minimum length from leading edge to trailing edge and the length from leading edge to trailing edge of the blades being shorter at their roots than at their tips, and wherein the angle made by the chords of the blades with planes containing the axis of rotation and intersecting said blades decreases from their roots towards their tips.

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